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OPTIMAL SELECTION OF FLEXIBLE PAVEMENT COMPONENTS

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by

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and

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OPTIMAL SELECTION OF FLEXIBLE PAVEMENT COMPONENTS

To: J. F. McLaughlin, Director
Joint Highway Research Project

September 13, 1968

Project No: C-36-52H

From: H. L. Michael, Associate Director
Joint Highway Research Project

File No: 6-20-8

The attached technical paper entitled "Optimal Selection of Flexible Pavement Components" has been prepared by Messrs. S. S. Hejal, T. R. Buick, and J. C. Oppenlander of our staff. The purpose of this systems analysis was to develop a rational method for the optimal selection of flexible pavement components. Minimum-cost thicknesses are determined for flexible pavements to satisfy the demands of traffic and environment on the system of pavement structure and soil support.

In total, 31,680 optimal flexible pavements were designed for highway construction conditions indicative of Indiana. Each flexible pavement section fulfills the design objectives for the least total cost.

The paper is presented to the Board for information.

Respectfully submitted,

Harold L. Michael

Harold L. Michael
Associate Director

HLM:mf

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Technical Paper

OPTIMAL SELECTION OF FLEXIBLE PAVEMENT COMPONENTS

by

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Joint Highway Research Project

Project No: C-36-52H

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Lafayette, Indiana

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OPTIMAL SELECTION OF FLEXIBLE PAVEMENT COMPONENTS

INFORMATIVE ABSTRACT

Although several methods are available for the design of flexible pavements, no existing technique explicitly considers the optimal combination of flexible pavement components to minimize the total in-place cost of the pavement system. The purpose of this systems analysis was to develop a rational method for the optimal selection of the thicknesses of the various pavement components. This cost minimization must be realized within the boundary conditions that are imposed by the practical limitations of the design parameters.

The design model consists of an objective function and seven constraint equations. The total cost of the pavement system is quantitatively described by this objective function, and a minimum-cost solution is obtained for each combination of material costs and design conditions. The various constraining equations quantify the boundary conditions to which the design of a flexible pavement is subject. These physical limitations complete the realism of the mathematical model in describing the real-world situation of flexible pavement design. The design model was solved by a modified linear programming technique.

In developing practical solutions to the design model, 31,680 optimal flexible pavements were designed for highway construction conditions indicative of Indiana. The thickness requirements for the various layers are specified for each combination of structural number, minimum total thickness, and unit costs of pavement materials. Cost savings which range from 2 to 15 percent result in the thickness selection of flexible pavement components by this design procedure.

OPTIMAL SELECTION OF FLEXIBLE PAVEMENT COMPONENTS

INTRODUCTION

The primary objective of highway pavement design is to provide an acceptable roadway surface that can withstand the deteriorating effects of traffic and environment for the service life of the facility. In addition, the pavement structure must adequately serve the demands of the road users at an acceptable level of performance. A properly designed, constructed, and maintained pavement is a major factor in providing economical, efficient, safe, convenient, and comfortable highway travel. This goal is an integral part of the total highway transportation program.

Although several design techniques are available for determining reasonable thicknesses of flexible pavements to satisfy the specified design parameters, no present method explicitly considers an optimization of flexible pavement components to minimize the total cost of the pavement system. Of course, this cost minimization must be realized within the boundary constraints imposed by the selected values of the design parameters. The purpose of this systems analysis was to develop a rational method for the optimal selection of flexible pavement components.

The objective of flexible pavement design in this investigation is to select the thicknesses of the various pavement components so that the total pavement cost is minimized within the limitations of the various design parameters for the procedure used by the Indiana State Highway Commission. Minimum-cost thicknesses are determined for flexible pavements to satisfy the demands of traffic and environment on the system of pavement structure and soil support. Therefore, this technique affords a practical and economical solution to the problem of designing the thicknesses of flexible pavements. This approach to design embodies the essence of sound engineering.

CONCEPTUAL MODEL

A flexible pavement distributes the traffic loads through a system of pavement components to the subgrade. These pavement layers are generally identified as surface, base, and subbase. Several different thickness combinations of the materials comprising the various components may adequately satisfy the structural design of the highway pavement. However, all satisfactory thickness arrangements may not provide an economical solution to the engineering problem of pavement design. In general, only one pavement structure is an optimal selection of the flexible pavement components for the designated design conditions.

The Indiana State Highway Commission predicates the total thickness of a flexible pavement on an estimated number of equivalent 18-kip single-axle load repetitions and on an appropriate measure of the soil support afforded by the subgrade. The combined effect of traffic loadings and soil support is denoted as a structural number (SN) according to the inte im design guide of the American Association of State Highway Officials for flexible pavements. A nomograph for determining structural numbers is presented as Figure 1 for average terminal serviceabilities on primary highways. Pavement component thicknesses are then selected to reproduce the specified structural number by a linear combination of layer thickness times its coefficient of relative strength. A minimum pavement thickness is equal to the summation of the component thicknesses.

Consideration of significant environmental factors, such as depth of frost penetration, may provide another control on the selection of a minimum pavement thickness. Several design procedures specify a minimum pavement thickness (T_{min}) to account for various influencing environmental

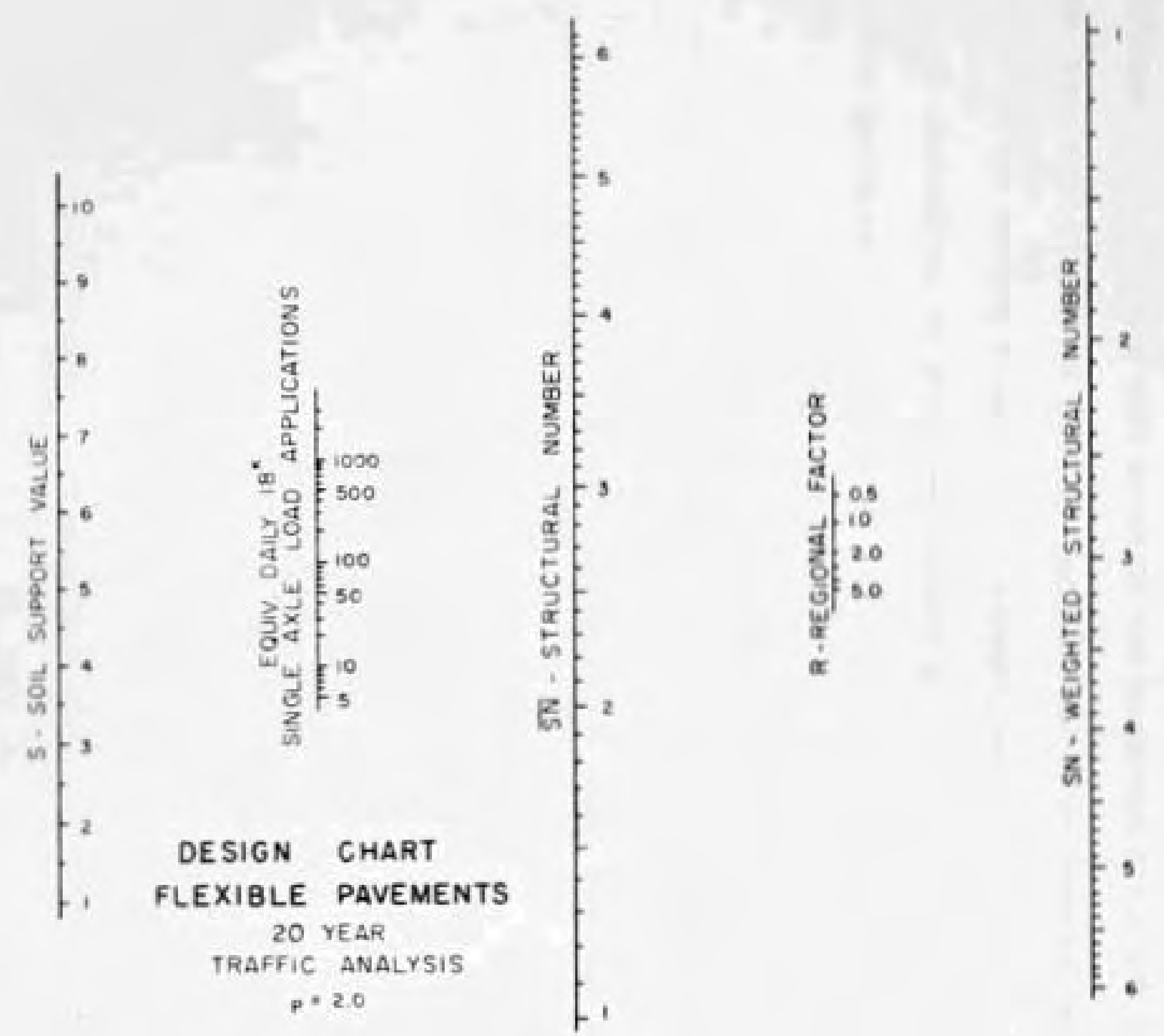

Figure I AASHO Flexible Design Chart

conditions. The greater minimum thickness value becomes the design requirement.

In a real sense, the minimum thicknesses represent design constraints and not design objectives. The design objective is to produce a flexible pavement system at the least total cost within the specified boundary conditions. The in-place unit costs of the component materials depend on the locale in which the flexible pavement is to be constructed. In addition to the traffic loading, soil support, and environment constraints, practical limitations on layer thicknesses are evident in highway construction practices.

DESIGN MODEL

The optimal selection of flexible pavement components is depicted by the following objective function:

$$\text{min.}\quad S = \left[\frac{C_1 D_1 k_1}{12 \times 2000}\right] d_1 + \left[\frac{C_2 D_2 k_j}{12 \times 2000}\right] d_2 +$$

$$\left[\frac{C_3 D_3 k_j}{12 \times 2000}\right] d_3 + \left[\frac{C_4 k_j}{12 \times 27}\right] d_4$$

where S = total cost of pavement system (dollars per square foot),

C_i = unit cost of material 'i' (dollars per ton for materials 1, 2, and 3 and dollars per cubic yard for material 4),

D_i = density of material 'i' (pounds per cubic foot),

d_i = thickness of material 'i' (inches),

i = 1 for bituminous surface, 2 for stabilized base, 3 for compacted aggregate base, and 4 for granular subbase, and

k_j = adjustment factor for increase in width of pavement layers;

k_1 = 1.00 for first layer,
k_2 = 1.04 for second layer,
k_3 = 1.08 for third layer, and
k_4 = 1.12 for fourth layer.

Thus, the objective of this optimal selection of flexible pavement components is to minimize the total cost of the pavement system. A typical cross-section for a flexible pavement is shown in Figure 2 in which the various material and layer notations of the design model are graphically described.

To quantify the boundary conditions to which the optimal selection of the thicknesses of the flexible pavement components is subject, the following constraint equations are necessary to complete the realism of this design model.

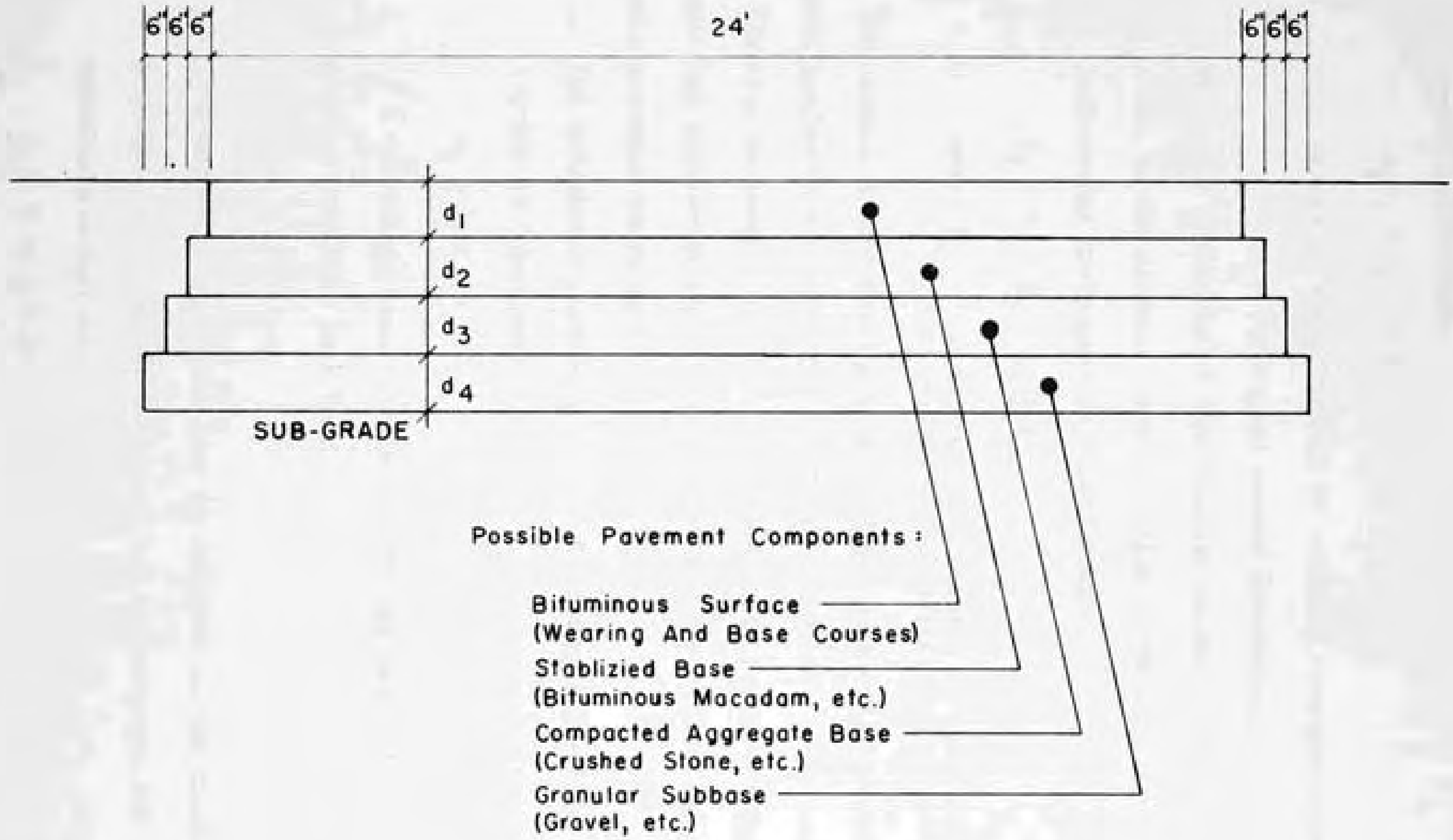

Figure 2 Typical Cross-Section Of A Flexible Pavement

1. The selection of layer thicknesses must satisfy the structural number requirement.

$$a_1d_1 + a_2d_2 + a_3d_3 + a_4d_4 \geq SN$$

where a_i = coefficient of relative strength of material 'i' and

SN = structural number for design.

2. The total thickness of the flexible pavement must be at least equal to the minimum thickness which is required by an influencing environmental consideration.

$$d_1 + d_2 + d_3 + d_4 \geq T_{min}$$

where T_{min} = total minimum thickness of flexible pavement to satisfy environmental conditions.

The remaining constraining equations are required to account for the physical limitations inherent in the construction of the various layers of a flexible pavement. The following seven relationships complete the mathematical representation of the concept for the optimal selection of flexible pavement components.

3. The bituminous surface course of a primary highway is at least 3.0 in. in thickness.

$$d_1 \geq 3.0$$

4. If a stabilized base is selected for the pavement system, the minimum thickness is 4.0 in.

$$d_2 = 0 \text{ or } \geq 4.0$$

5. If a compacted aggregate base is included in the flexible pavement, a minimum thickness of 4.0 is necessary for construction purposes.

$$d_3 = 0 \text{ or } \geq 4.0$$

6. If a granular subbase is specified from the optimal selection, at least a 4.0-in. layer is required.

   $d_4 = 0$ or ≥ 4.0

7. Because rutting and shoving of the pavement surface may result under high load repetitions for excessive thicknesses of bituminous mixtures, the maximum thickness of the bituminous surface is 10.0 in.

   $d_1 \leq 10.0$

8. The maximum thickness of the stabilized base is established at 10.0 in. because of large vertical deformations that may result in this base course if excessive thicknesses of bituminous mixtures are used.

   $d_2 \leq 10.0$

9. An upper limit of 20.0 in. is set for the thickness of the granular subbase to conform with present construction practice in the State of Indiana.

   $d_4 \leq 20.0$

In summary, the optimal selection of flexible pavement components is predicated on determining that minimum-cost combination of layer thicknesses which satisfy the real and practical constraining conditions. The selection of actual in-place construction costs enhances the mathematical representation of the flexible pavement design process and provides further economies in the highway construction industry.

SOLUTION

The final step in determining the optimal selection of flexible pavement components was to obtain a solution to the design model. This solution optimizes the objective function and is subject to the set of constraining situations. The optimization process was performed in two stages. In the first phase, the following six separate arrangements of flexible pavement components were optimized by a linear programming algorithm.

1. Bituminous surface and stabilized base;
2. Bituminous surface, stabilized base, and compacted aggregate base;
3. Bituminous surface, stabilized base, and granular subbase;
4. Bituminous surface, stabilized base, compacted aggregate base, and granular subbase;
5. Bituminous surface and compacted aggregate base; and
6. Bituminous surface, compacted aggregate base, and granular subbase.

These six layered combinations of pavement components represent all possible flexible pavement systems considered in this optimization problem. The other phase of the solution involved the selection of that pavement-component arrangement which minimizes the total cost for the selected unit costs of the pavement materials. This final solution represents the global optimum, and no better solution exists for the specified pavement design and material cost parameters.

To develop optimal flexible pavement designs for primary highways in the State of Indiana, the pavement materials shown in Table 1 were incorporated in the design model. The respective coefficients of relative strength and in-place densities are indicated in this table for the selected bituminous surface, stabilized base, compacted aggregate base,

Table 1

PAVEMENT MATERIAL SPECIFICATIONS

Material Notation	Material Description	Coefficient of Relative Strength, a_i	Density, D_i (lb/cu ft)
d_1	Bituminous surface	0.44	140
d_2	Stabilized base	0.24	130
d_3	Compacted aggregate base	0.14	135
d_4	Granular subbase	0.08	---

and granular subbase. The pavement materials conform to the specifications of the Indiana State Highway Commission. The appropriate unit cost values for the materials in-place are summarized in Table 2. The cost ranges were selected to be representative of construction conditions in Indiana. The range and incremental values of cost specified in Table 2 result in 192 cost arrangements for the four pavement materials.

The optimal selection of flexible pavement components was developed for 15 structural numbers and 11 minimum total thicknesses. The structural numbers range from 2.50 to 6.00 in increments of 0.25, and the minimum total thicknesses represent values from 13.0 to 23.0 in. in 1.0-in. increments. Thus, 31,680 optimal flexible pavements were designed for highway construction conditions indicative of Indiana. Six sample design tables are presented in the Appendix to illustrate the results for the optimal selection of flexible pavement components. The thickness requirements for the four layers of a flexible pavement are specified for each combination of structural number, minimum total thickness, and unit costs of pavement materials. Each flexible pavement section fulfills the design objectives for the least total cost.

Table 2

UNIT MATERIAL COSTS

Material Notation	Unit Cost Range	Unit Cost Increment
d_1	8.00 - 11.00, \$/ton	1.00, \$/ton
d_2	5.00 - 8.00, \$/ton	1.00, \$/ton
d_3	3.00 - 5.00, \$/ton	1.00, \$/ton
d_4	3.00 - 6.00, \$/cu yd	1.00, \$/cu yd

DESIGN EXAMPLE

To illustrate the application of the design charts, the following example represents a typical situation for the design of a flexible pavement for a primary state highway. The strength of the subgrade is represented by a soil support value of 4.0, and the depth of frost penetration is 18.0 in. in this area. The traffic forecast for the design year is estimated to be 325 equivalent 18-kip, single-axle load applications per day. If the regional factor is equal to 1.0, the structural number (SN) is read as 3.75 from figure 1 for the specified subgrade characteristics, traffic loadings, and environmental conditions. In addition, a minimum pavement thickness (T_{min}) of 18.0 in. is specified to provide a design for full frost penetration. This constraint accounts for the environmental influence of frost action.

The estimated in-place costs for the various available materials are \$9.00 per ton for the bituminous surface, \$7.00 per ton for the stabilized base, \$4.00 per ton for the compacted aggregate base, and \$3.00 per cu yd for the granular subbase. Of course, the economics of selecting the design thicknesses are enhanced with an accurate knowledge of the true construction costs which are generally known only to the contractor. The appropriate design chart for the example cost values is Table 6 in the Appendix. The optimal selection of the flexible pavement components is a bituminous surface of 5.7 in., a compacted aggregate base of 4.0 in., and a granular subbase of 8.3 in. This best solution does not include any stabilized base in the cross-section of the flexible pavement selected for this design example.

The resultant design provides the least-cost flexible pavement which is 18.0 in. in total thickness and satisfies the imposed structural and frost-action constraints. In-place cost savings of 6 to 17 percent have been evidenced in the thickness selection of flexible pavement components by this design model.

APPENDIX

SAMPLE DESIGN TABLES

for

OPTIMAL SELECTION OF FLEXIBLE PAVEMENT COMPONENTS

C(1)= 8.00$/TON   C(2)= 5.00$/TON   C(3)= 3.00$/TON   C(4)= 5.00$/TON

	SN= 2.50	SN= 2.75	SN= 3.00	SN= 3.25	SN= 3.50	SN= 3.75	SN= 4.00	SN= 4.25	SN= 4.50	SN= 4.75	SN= 5.00	SN= 5.25	SN= 5.50	SN= 5.75	SN= 6.00
T=13.0	2.4	4.1	4.9	5.4	6.0	6.5	7.3	8.1	8.9	9.5	9.2	9.7	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.0	4.0	4.8	5.6	6.7
	4.0	4.0	4.0	4.0	4.0	4.0	5.7	4.9	5.1	4.0	0.	0.	0.	0.	0.
	7.4	4.9	4.2	4.2	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=14.0	9.3	3.7	4.4	5.2	5.9	6.5	7.1	7.7	8.3	9.1	10.0	9.6	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.5	4.8	5.8	6.7
	4.0	4.7	4.1	4.0	4.0	4.0	4.0	4.0	5.5	4.1	4.3	0.	0.	0.	0.
	8.1	8.1	5.6	4.7	4.1	4.0	4.0	4.0	0.	0.	0.	0.	0.	0.	0.
T=15.0	3.0	3.3	4.3	5.0	5.7	6.4	7.1	7.7	8.2	8.8	9.7	10.0	9.5	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.5	5.8	6.7
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.2	5.3	6.1	0.	0.	0.
	8.6	7.5	6.7	5.7	5.3	4.4	4.0	4.0	4.0	0.	0.	0.	0.	0.	0.
T=16.0	3.0	3.4	4.1	4.9	5.3	6.2	6.9	7.6	8.2	8.8	9.4	10.0	9.6	9.5	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.0	6.5	6.7
	4.0	4.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	6.1	0.	0.	0.
	9.0	8.5	7.4	7.7	6.5	5.8	5.1	4.5	5.0	4.0	4.0	0.	4.0	0.	0.
T=17.0	3.0	3.2	3.9	4.6	5.3	6.0	6.7	7.4	8.1	8.7	9.4	9.9	9.6	10.0	9.6
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.0	4.3	7.4
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.	0.	0.
	10.0	9.3	9.1	8.6	7.7	7.0	6.3	5.6	4.9	4.2	4.0	4.0	4.0	4.0	0.
T=18.0	3.0	3.0	3.7	4.4	5.1	5.7	6.4	7.1	7.9	8.5	9.7	9.9	9.5	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.0	4.3	5.3
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.	0.	0.
	11.0	11.0	10.3	9.6	8.9	8.2	7.6	6.9	6.7	5.5	4.9	4.1	4.5	4.0	4.0
T=19.0	3.0	3.0	3.4	4.1	4.8	5.5	6.2	6.9	7.5	8.3	9.0	9.7	9.3	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.0	4.0	5.3
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.	0.	0.
	12.0	12.0	11.6	10.9	10.2	9.5	8.8	8.1	7.4	6.7	6.0	5.3	5.7	5.0	4.0
T=20.0	3.0	3.0	3.2	3.9	4.6	5.3	6.2	6.7	7.4	8.1	8.8	9.5	10.0	9.7	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.0	5.3
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.	0.
	13.0	13.0	12.8	12.1	11.4	10.7	10.0	9.3	8.6	7.9	7.2	6.5	5.7	6.2	5.0
T=21.0	3.0	3.0	3.0	3.7	4.4	5.1	5.8	6.5	7.2	7.9	8.6	9.2	9.9	9.8	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.0	4.8
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.	0.
	14.0	14.0	14.0	13.3	12.6	11.9	11.2	10.5	9.8	9.1	8.4	7.7	7.1	7.5	6.9
T=22.0	3.0	3.0	3.0	3.5	4.2	4.9	5.6	6.2	6.9	7.6	8.3	9.0	9.7	9.3	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.0	4.0
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.	0.
	15.0	15.0	15.0	14.5	13.8	13.1	12.4	11.7	11.1	10.4	9.7	9.0	8.3	8.7	8.0
T=23.0	3.0	3.0	3.0	3.2	3.9	4.6	5.3	6.0	6.7	7.4	8.1	8.8	9.5	10.0	9.6
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.0
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.
	16.0	16.0	16.0	15.7	15.1	14.4	13.7	13.0	12.3	11.6	10.9	10.2	9.5	8.9	9.2

C(1)= 9.00$/TON C(2)= 6.00$/TON C(3)= 3.00$/TON C(4)= 4.00$/YD3

	SN= 2.50	SN= 2.75	SN= 3.00	SN= 3.25	SN= 3.50	SN= 3.75	SN= 4.00	SN= 4.25	SN= 4.50	SN= 4.75	SN= 5.00	SN= 5.25	SN= 5.50	SN= 5.75	SN= 6.00
T=13.C	3.1	3.1	3.9	4.8	5.6	6.4	7.3	8.1	8.9	9.5	10.0	10.0	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	5.4	4.9	7.1	4.7	7.4	6.6	5.7	4.9	4.1	4.0	4.3	6.1	7.9	9.6	11.4
	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=14.C	3.0	3.4	3.5	4.3	5.1	6.0	5.8	7.6	8.5	9.3	10.0	10.0	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	5.0	6.6	10.5	9.7	8.9	8.0	7.7	6.4	5.5	4.7	4.3	6.1	7.9	9.6	11.4
	6.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=15.C	3.0	3.0	3.0	3.8	4.7	5.5	6.3	7.2	8.0	8.8	9.7	10.0	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	7.8	12.0	11.2	10.3	9.5	8.7	7.8	7.0	6.2	5.3	6.1	7.9	9.6	11.4
	8.0	4.2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=16.C	3.0	3.0	3.3	3.5	4.2	5.0	5.9	6.7	7.5	8.4	9.2	10.0	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	6.5	8.7	12.6	11.8	11.0	10.1	9.3	8.5	7.6	6.8	6.1	7.9	9.6	11.4
	9.0	8.5	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=17.C	3.0	3.0	3.0	3.0	3.7	4.6	5.4	6.2	7.1	7.9	8.7	9.6	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	5.2	9.3	14.0	13.3	12.4	11.6	10.8	9.9	9.1	8.3	7.4	7.9	9.6	11.4
	10.0	8.8	4.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=18.C	3.0	3.0	3.0	3.2	3.3	4.1	4.9	5.8	6.6	7.4	8.3	9.1	9.9	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	8.0	10.8	14.7	13.9	13.1	12.2	11.4	10.6	9.7	8.9	8.1	9.6	11.4
	11.0	11.0	7.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=19.C	3.0	3.0	3.0	3.0	3.0	3.6	4.5	5.3	6.1	7.0	7.8	8.6	9.5	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	6.7	10.8	16.0	15.4	14.5	13.7	12.9	12.0	11.2	10.4	9.5	9.6	11.4
	12.0	12.0	9.3	5.2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=20.C	3.0	3.0	3.0	3.0	3.1	3.2	4.0	4.8	5.7	6.5	7.3	8.2	9.0	9.8	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	5.3	9.5	12.3	16.8	16.0	15.2	14.3	13.5	12.7	11.8	11.0	10.2	11.4
	13.0	13.0	11.7	7.5	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=21.C	3.0	3.0	3.0	3.0	3.0	3.0	3.5	4.4	5.2	6.0	6.9	7.7	8.5	9.4	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	8.2	12.3	18.0	17.5	16.6	15.8	15.0	14.1	13.3	12.5	11.6	11.4
	14.0	14.0	14.0	9.8	5.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=22.C	3.0	3.0	3.0	3.0	3.0	3.0	3.1	3.9	4.7	5.6	6.4	7.2	8.1	8.9	9.7
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	6.8	11.0	15.0	18.9	18.1	17.3	16.4	15.6	14.8	13.9	13.1	12.3
	15.0	15.0	15.0	12.2	8.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=23.C	3.0	3.0	3.0	3.0	3.0	3.0	3.4	3.4	4.3	5.1	5.9	6.8	7.6	8.4	9.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	5.5	9.7	13.8	15.6	19.6	18.7	17.9	17.1	16.2	15.4	14.6	13.7
	16.0	16.0	16.0	14.5	10.3	6.2	4.0	0.	0.	0.	0.	0.	0.	0.	0.

C(1)= 5.00$/TON   C(2)= 6.00$/TON   C(3)= 4.00$/TON   C(4)= 3.00$/YD3

	SN= 2.50	SN= 2.75	SN= 3.00	SN= 3.25	SN= 3.50	SN= 3.75	SN= 4.00	SN= 4.25	SN= 4.50	SN= 4.75	SN= 5.00	SN= 5.25	SN= 5.50	SN= 5.75	SN= 6.00
T=13.C	3.4	3.0	3.7	4.4	5.0	5.6	6.2	6.7	7.3	7.9	9.2	9.7	9.6	10.0	10.0
	0.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	5.6	6.0	5.3	4.6	4.0	4.0	4.0	4.0	4.0	4.0	0.	0.	4.0	4.9	8.0
T=14.C	3.7	3.9	3.4	4.1	4.8	5.5	6.2	6.7	7.3	7.9	8.5	9.0	9.6	10.0	10.0
	0.	0.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	6.8	6.3	6.5	5.9	5.2	4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.9	8.0
T=15.C	3.0	3.6	3.2	3.9	4.6	5.3	6.0	6.7	7.3	7.9	8.5	9.0	9.6	10.0	10.0
	0.	0.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	8.0	7.4	7.8	7.1	6.4	5.7	5.0	4.3	4.0	4.0	4.0	4.0	4.0	4.9	8.0
T=16.C	3.0	3.4	3.0	3.7	4.4	5.1	5.8	6.5	7.2	7.9	8.5	9.0	9.6	10.0	10.5
	0.	0.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	9.0	8.6	9.0	8.3	7.6	6.9	6.2	5.5	4.8	4.1	4.0	4.0	4.0	4.9	8.0
T=17.C	3.0	3.2	3.9	3.5	4.2	4.9	5.6	6.2	6.9	7.6	8.3	9.0	9.6	10.0	10.0
	0.	0.	0.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	10.0	9.8	9.1	9.5	8.8	8.1	7.4	6.7	6.1	5.4	4.7	4.0	4.0	4.9	8.0
T=18.C	3.0	3.0	3.7	3.2	3.9	4.6	5.3	6.0	6.7	7.4	8.1	8.9	9.5	10.0	10.0
	0.	0.	0.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	11.0	11.0	10.3	10.7	10.1	9.4	8.7	8.0	7.3	6.6	5.9	5.2	4.5	4.9	8.0
T=19.C	3.0	3.0	3.4	3.0	3.7	4.4	5.1	5.8	6.5	7.2	7.9	8.6	9.3	10.0	10.0
	0.	0.	0.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	12.0	12.0	11.6	12.0	11.3	10.6	9.9	9.2	8.5	7.8	7.1	6.4	5.7	5.0	8.0
T=20.C	3.0	3.0	3.2	3.9	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4	9.1	9.7	10.0
	0.	0.	0.	0.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	13.0	13.0	12.8	12.1	12.5	11.8	11.1	10.4	9.7	9.0	8.3	7.6	6.9	6.2	8.0
T=21.C	3.0	3.0	3.0	3.7	3.3	4.0	4.7	5.4	6.1	6.7	7.4	8.1	8.8	9.5	10.0
	0.	0.	0.	0.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	14.0	14.0	14.0	13.3	13.7	13.0	12.3	11.6	10.9	10.2	9.6	8.9	8.2	7.5	8.0
T=22.C	3.0	3.0	3.0	3.5	3.1	3.7	4.4	5.1	5.8	6.5	7.2	7.9	8.6	9.3	10.0
	0.	0.	0.	0.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	15.0	15.0	15.0	14.4	14.9	14.2	13.6	12.9	12.2	11.5	10.8	10.1	9.4	8.7	8.0
T=23.C	3.0	3.0	3.0	3.2	3.9	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4	9.1	9.8
	0.	0.	0.	0.	0.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	4.0	4.0	4.0	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	16.0	16.0	16.0	15.7	15.1	15.5	14.8	14.1	13.4	12.7	12.0	11.3	10.6	9.9	9.2

C(1)= 9.00$/TON   C(2)= 7.00$/TON   C(3)= 4.00$/TON   C(4)= 3.00$/YD3

	SN= 2.50	SN= 2.75	SN= 3.00	SN= 3.25	SN= 3.50	SN= 3.75	SN= 4.00	SN= 4.25	SN= 4.50	SN= 4.75	SN= 5.00	SN= 5.25	SN= 5.50	SN= 5.75	SN= 6.00
T=13.0	3.4	4.1	4.8	5.4	6.0	6.5	7.1	7.7	8.9	9.5	10.0	9.9	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.0	4.3	4.0	4.0	4.0	4.0
	5.6	4.9	4.7	4.0	4.0	4.0	4.0	4.0	0.	0.	0.	4.0	6.7	9.9	13.0
T=14.0	3.2	3.9	4.6	5.2	5.9	6.5	7.1	7.7	8.2	8.8	10.0	9.9	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.3	4.0	4.0	4.0	4.0
	6.8	6.1	5.4	4.8	4.1	4.0	4.0	4.0	4.0	4.0	0.	4.0	6.7	9.9	13.0
T=15.0	3.0	3.6	4.3	5.0	5.7	6.4	7.1	7.7	8.7	8.8	9.4	9.9	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	8.0	7.4	6.7	6.0	5.3	4.6	4.0	4.0	4.0	4.0	4.0	4.0	6.7	9.9	13.0
T=16.0	3.0	3.4	4.1	4.8	5.5	6.2	6.9	7.6	8.2	8.8	9.4	9.9	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	9.0	8.6	7.9	7.2	6.5	5.8	5.1	4.4	4.0	4.0	4.0	4.0	6.7	9.9	13.0
T=17.0	3.0	3.2	3.9	4.6	5.3	6.0	6.7	7.4	8.1	8.7	9.4	9.9	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	10.0	9.8	9.1	8.4	7.7	7.0	6.3	5.6	4.9	4.2	4.0	4.0	6.7	9.9	13.0
T=18.0	3.0	3.0	3.7	4.4	5.1	5.7	6.4	7.1	7.8	8.5	9.2	9.9	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	11.0	11.0	10.3	9.6	8.9	8.3	7.6	6.9	6.2	5.5	4.8	4.1	6.7	9.9	13.0
T=19.0	3.0	3.0	3.4	4.1	4.8	5.5	6.2	6.9	7.6	8.3	9.0	9.7	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	12.0	12.0	11.6	10.9	10.2	9.5	8.8	8.1	7.4	6.7	6.0	5.3	6.7	9.9	13.0
T=20.0	3.0	3.0	3.2	3.9	4.6	5.3	6.0	6.7	7.4	8.1	8.8	9.5	10.0	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	13.0	13.0	12.8	12.1	11.4	10.7	10.0	9.3	8.6	7.9	7.2	6.5	6.7	9.9	13.0
T=21.0	3.0	3.0	3.0	3.7	4.4	5.1	5.8	6.5	7.2	7.9	8.6	9.2	9.9	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	14.0	14.0	14.0	13.3	12.6	11.9	11.2	10.5	9.8	9.1	8.4	7.7	7.1	9.9	13.0
T=22.0	3.0	3.0	3.0	3.5	4.2	4.9	5.6	6.2	6.9	7.6	8.3	9.0	9.7	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	15.0	15.0	15.0	14.5	13.8	13.1	12.4	11.7	11.1	10.4	9.7	9.0	8.3	9.9	13.0
T=23.0	3.0	3.0	3.0	3.2	3.9	4.6	5.3	6.0	6.7	7.4	8.1	8.8	9.5	10.0	10.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	16.0	16.0	16.0	15.7	15.1	14.4	13.7	13.0	12.3	11.6	10.9	10.2	9.5	9.9	13.0

C(1)=10.00$/TON C(2)= 5.00$/TON C(3)= 3.00$/TON C(4)= 4.00$/TON

	SN= 2.50	SN= 2.75	SN= 3.00	SN= 3.25	SN= 3.50	SN= 3.75	SN= 4.00	SN= 4.25	SN= 4.50	SN= 4.75	SN= 5.00	SN= 5.25	SN= 5.50	SN= 5.75	SN= 6.00
T=13.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	5.3	6.7	10.0	10.0	9.9	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	6.1	10.2	12.0	4.7	4.0	0.	0.	4.0	5.6	7.4	9.1	10.9	12.7	14.5	16.3
	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=14.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	4.0	6.4	7.8	8.8	9.9	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	5.0	7.9	12.0	7.0	4.0	4.0	4.0	4.0	5.6	7.4	9.1	10.9	12.7	14.5	16.3
	4.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=15.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	5.0	7.5	8.8	9.9	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	4.0	7.8	12.0	13.8	7.0	4.5	4.0	4.0	5.6	7.4	9.1	10.9	12.7	14.5	16.3
	8.0	4.2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=16.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	6.1	8.6	9.9	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	4.0	6.5	9.7	13.8	15.6	6.9	4.4	4.0	5.6	7.4	9.1	10.9	12.7	14.5	16.3
	9.0	6.5	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=17.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	4.7	7.2	9.7	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	4.0	5.2	9.3	14.0	15.6	9.3	6.8	4.3	5.6	7.4	9.1	10.9	12.7	14.5	16.3
	10.0	8.8	4.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=18.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	5.8	8.3	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	4.0	4.0	8.0	11.5	15.6	17.4	9.7	6.7	5.6	7.4	9.1	10.9	12.7	14.5	16.3
	11.0	11.0	7.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=19.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	4.4	6.9	9.4	10.0	10.0	10.0	10.0	10.0	10.0
	4.0	4.0	6.7	10.8	16.0	17.4	11.6	9.1	6.6	7.4	9.1	10.9	12.7	14.5	16.3
	12.0	12.0	9.3	5.2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=20.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	0.	5.5	4.0	10.0	10.0	10.0	10.0	10.0	10.0
	4.0	4.0	5.3	9.5	13.3	17.4	19.1	11.5	9.0	7.4	9.1	10.9	12.7	14.5	16.3
	13.0	13.0	11.7	7.5	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=21.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	0.	0.	6.6	9.1	10.0	10.0	10.0	10.0	10.0
	4.0	4.0	4.0	8.2	12.3	19.0	19.1	20.9	11.4	8.0	9.1	10.9	12.7	14.5	16.3
	14.0	14.0	14.0	7.8	5.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=22.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	0.	0.	5.2	7.7	10.0	10.0	10.0	10.0	10.0
	4.0	4.0	4.0	6.8	11.0	15.1	19.1	20.9	13.8	11.3	9.1	10.9	12.7	14.5	16.3
	15.0	15.0	15.0	12.2	8.0	4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=23.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	6.3	8.8	10.0	10.0	10.0	10.0
	4.0	4.0	4.0	5.5	9.7	13.8	16.9	20.9	22.7	13.7	11.2	10.9	12.7	14.5	16.3
	16.0	16.0	16.0	14.5	10.3	6.2	4.0	0.	0.	0.	0.	0.	0.	0.	0.

C(1)=11.00$/TON C(2)= 5.00$/TON C(3)= 3.00$/TON C(4)= 6.00$/TON

	SN= 2.50	SN= 2.75	SN= 3.00	SN= 3.25	SN= 3.50	SN= 3.75	SN= 4.00	SN= 4.25	SN= 4.50	SN= 4.75	SN= 5.00	SN= 5.25	SN= 5.50	SN= 5.75	SN= 6.00
T=13.C	3.0	3.0	3.0	3.0	3.0	3.1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	5.3	6.7	10.0	9.8	9.9	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	10.0	10.2	12.0	4.7	4.0	0.	4.0	4.0	5.6	7.4	9.1	10.9	12.7	14.5	16.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=14.C	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	4.0	6.4	7.8	8.4	9.9	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	11.0	11.0	12.0	7.0	4.8	4.0	4.0	4.0	5.5	7.4	9.1	10.9	12.7	14.5	16.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=15.C	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	5.0	7.5	8.8	7.8	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	12.0	12.0	12.0	13.0	7.0	4.5	4.0	4.0	5.6	7.4	9.1	10.9	12.7	14.5	16.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=16.C	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	6.1	8.6	9.9	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	13.0	13.0	13.0	13.0	13.0	6.6	4.4	4.0	5.5	7.4	9.1	10.9	12.7	14.5	16.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=17.C	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	4.7	7.2	9.7	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	14.0	14.0	14.0	14.0	15.8	5.7	4.8	4.3	5.6	7.4	9.1	10.9	12.7	14.5	16.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=18.C	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	5.8	8.3	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	15.0	15.0	15.0	15.0	15.8	17.8	4.7	8.7	5.6	7.4	9.1	10.9	12.7	14.5	16.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=19.C	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	4.4	8.9	9.4	10.0	10.0	10.0	10.0	10.0	10.0
	16.0	16.0	16.0	16.0	16.0	17.6	11.6	9.1	6.6	7.4	9.1	10.9	12.7	14.5	16.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=20.C	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	0.	5.9	8.2	10.0	10.0	10.0	10.0	10.0	10.0
	17.0	17.0	17.0	17.0	17.0	17.6	19.1	11.5	9.5	7.4	9.1	10.9	12.7	14.5	16.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=21.C	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	0.	0.	5.5	9.1	10.0	10.0	10.0	10.0	10.0
	18.0	18.0	18.0	18.0	18.0	18.0	19.1	20.9	11.6	7.4	9.1	10.9	12.7	14.5	16.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=22.C	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	0.	0.	5.2	7.7	10.0	10.0	10.0	10.0	10.0
	19.0	19.0	19.0	19.0	19.0	19.0	19.1	20.9	13.0	11.5	9.1	10.9	12.7	14.5	16.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T=23.C	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.1	9.0	10.0	10.0	10.0	10.0
	20.0	20.0	20.0	20.0	20.0	20.0	20.9	20.9	21.7	13.7	11.2	10.9	12.7	14.5	16.3
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.